

REMARKS

Claims 10-13, 18-21, 26-29, 34, and 35 are pending in this application. By this Amendment, claims 14-17, 22-25, 30-33, 36, and 37 are canceled and claims 10 and 34 are amended. Support for the amendments to claims 10 and 34 is found in, for example, canceled claims 14 and 36. No new matter is added.

Rejection under 35 U.S.C. §103(a)

The Examiner rejected claims 10-37 under 35 U.S.C. §103(a) as being unpatentable over Japanese Publication No. 2000-351690 ("Toshio"). Applicants respectfully traverse the rejection.

Claim 10 and its dependent claims are directed to a method of producing a silicon single crystal, wherein the single crystal wafer produced is a P-doped silicon single crystal having an aluminum concentration of at least 2×10^{12} atoms/cc and a defect-free I region at the lower rate side of the N region. Thus, the defect-free region is expanded from the conventionally limited N region to the I region, wherein the I region is also defect-free, in terms of LFPD and LSEPD. The advantages of such a silicon single crystal include the excellent electrical characteristics set forth in the specification at, for example, page 7, lines 12-25, and page 8, lines 21-26.

Similarly, the silicon single crystal wafer of claim 34 and its dependent claims is a P-doped silicon single crystal wafer having an aluminum concentration of at least 2×10^{12} atoms/cc, wherein the whole plane of the wafer is the N region and/or I region.

The Examiner stated that Toshio discloses the claimed invention except it does not teach an F/G value of 2 or less, a melting point of silicon of 1400°C, or an aluminum concentration of at least 2×10^{12} atoms/cc. The Examiner also stated that the disclosure in Toshio of "changing the pulling velocity V and temperature gradient in the crystal along the radial direction" is similar to Applicants' F/G "value." Office Action, p. 3. Thus, it would

have been obvious to one of ordinary skill in the art to "modify and optimize the process and product parameter limitation in order to ensure proper orientation. The motivation being that a silicon single-crystal can be formed with a defect-free area while also providing a good yield." Office Action, p. 3.

To establish a *prima facie* case of obviousness, the Examiner must provide a suggestion, teaching, or motivation to modify the applied reference, *and* there must be a reasonable expectation of success of obtaining the claimed invention once the reference is modified. In this case, although the applied reference may recite some of the elements of the claimed invention, it does not teach or suggest the selective combination of all the elements set forth in the claims, and, in fact, teaches away from the selective combination. Thus, there is no motivation, teaching, or suggestion to modify Toshio and no likelihood of successfully obtaining the claimed invention.

Notably, the Examiner focused on the differences between Toshio and the current claims. However, it is the invention as whole that must be considered in an obviousness analysis. "Focusing on the obviousness of substitutions and differences, instead of on the invention as a whole, is a legally improper way to simplify the often difficult determination of obviousness." *Gillette Company v. S.C. Johnson & Son, Inc.*, 919 F.2d 720 (Fed. Cir. 1990).

In this case, the Examiner focused on, for example, the dopants cited in the Toshio translated abstract and those set forth in the claims. Dopants are intentionally added when manufacturing silicon single crystal to control the conduction type, i.e., P or N, and to control specific resistance to manufacturing. Group III elements, such as boron and aluminum, act as acceptors to generate a P-type crystal as is known in the art and recognized by Applicants. *See, e.g.*, specification, p. 15, lines 14-16. To make an N-type crystal, Group V elements, such as phosphorus, are employed, as is also known in the art and recognized by Applicants. *See, e.g.*, specification, p. 10, lines 7-10. It is against common wisdom in the art to combine

dopants used for different conductivities as noted by Toshio in column 4, paragraph three, of the Japanese publication. *See also* machine translated version of Toshio, section entitled "Detailed Description," paragraph three. Thus, when the Toshio abstract is read in context, it is clear that it discloses *alternate* dopants. Contrary to the Examiner's conclusion, one of ordinary skill in the art would not consider it obvious to generate a P-doped N-type silicon single crystal wafer having a P-type dopant, i.e., aluminum, at a concentration of at least 2×10^{12} atoms/cc.

Moreover, the silicon single crystal or the silicon single crystal wafer set forth in the claims are defect-free in the N-region *and* I-region, in terms of LFPD and LSEPD. Conventionally, only the N-region in such wafers is defect-free, which renders productivity and yield low. Applicants discovered a mechanism by which the conventional defect-free region could be expanded. By manipulating the dopant concentrations, Applicants determined that the defect-free region could extend into the I-region. One of ordinary skill in the art following the teachings of Toshio would not arrive at the claimed invention because Toshio does not teach the dopants and dopant concentrations necessary to obtain a defect-free N-region and/or I-region as claimed.

Because the applied reference does not suggest the particular form of the invention as claimed, Applicants respectfully assert that no *prima facie* case of obviousness exists.

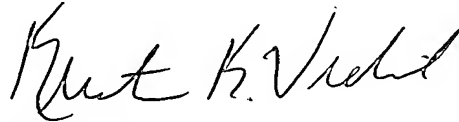
Reconsideration and withdrawal of the rejection are respectfully requested.

Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 10-13, 18-21, 26-29, 34, and 35 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



William P. Berridge
Registration No. 30,024

Kristin K. Vidovich
Registration No. 41,448

WPB:KKV/hs

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OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400

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